500.41184X00

UNITED STATES PATENT AND TRADEMARK OFFICE

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Serial No.:   10/073,007

Filed: February 12, 2002

For: SYSTEM AND METHOD FOR OPERATION AND MANAGEMENT OF STORAGE APPARATUS

Group: 3627

Examiner: R. Laneau

SUBMISSION OF SWORN ENGLISH
TRANSLATION OF PRIORITY DOCUMENT

Commissioner for Patents   December 14, 2006
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Attached is a Sworn English Translation of the priority documents submitted on even date herein for the above-referenced application. The attached is being submitted in order to perfect Applicants claim of priority.

To the extent necessary, applicants petition for an extension of time under 37 C.F.R. section 1.136. Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account No. 50-1417 (Case No. 500.41184X00) and please credit any excess fees to such Deposit Account.

Respectfully submitted,
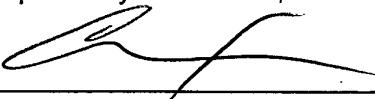
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CIB/jdc
703/684-1120

DECLARATION

I, Takayuki HATANAKA, a national of Japan,

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do hereby solemnly and sincerely declare:

1) THAT I am well acquainted with the Japanese language
   and English language, and

2) THAT the attached is a full, true, accurate and
   faithful translation into the English language made
   by me of Japanese Patent Application No. 2001-361908.

The undersigned declares further that all
statements made herein of his own knowledge are true and
that all statements made on information and belief are
believed to be true; and further that these statements
were made with the knowledge that willful false statements
and the like so made are punishable by fine or imprisonment,
or both, under section 1001, of Title 18 of the United
States Code and that such willful false statements may
jeopardize the validity of the application or any patent
issuing thereon.

Signed this 11th day of December, 2006.

Takayuki Hatanaka
_____
Takayuki HATANAKA

[Title of Document]	Patent Application
[Reference Number]	K01011281A
[Addressee]	Commissioner
	The Patent Office

[International Patent Classification]   G06F 17/60

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[Indication on Fee]

    [Prepayment Register Number]   013088

    [Amount of Payment]   ¥21,000-

[List of Items Filed]

    [Title of Article]   Specification 1

    [Title of Article]   Drawings 1

    [Title of Article]   Abstract 1

[Proof Required or not]   yes

[Kind of Document]   Description

[Title of the Invention]   A SYSTEM AND METHOD FOR

OPERATION AND MANAGEMENT OF

5   STORAGE APPARATUS

[Kind of Document]   Claims

[Claim 1]   An operating/managing system connected to a

computer and at least one storage apparatus, comprising:

10   computer connecting means for establishing a

connection with said computer;

         at least two storage apparatus connecting

means for establishing connections with said storage

apparatuses respectively;

15   property holding means for holding a property

of said storage apparatus connected to said computer;

         storage apparatus information holding means

for holding information on a storage apparatus selected

on the basis of said information stored in said property

20   holding means;

         connection destination switching means for

distributing information into said storage apparatus

connecting means in a state where a destination address

of said information has been switched in accordance with

25   said information held in said storage apparatus

information holding means, said information being

received from said computer;

         information duplicating means for controlling

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reading-out of information from said storage apparatus
and writing-in of said information into said storage
apparatus on the basis of said information held in said
storage apparatus information holding means; and

5   volume requesting means for requesting
allocation of a volume to said storage apparatus
connected to said computer.

[Claim 2]   The operating/managing system of said storage
apparatuses as claimed in Claim 1, wherein said storage
10   apparatus connected to said computer includes volume
allocating means for allocating said volume in
accordance with said volume allocating request from said
volume requesting means,

          said volume requesting means requesting, in
15   accordance with said information held in said storage
apparatus information holding means, allocation of a
volume to volume allocating means in another storage
apparatus,

          said information duplicating means
20   duplicating, in accordance with said information held in
said storage apparatus information holding means, said
information from a volume in said storage apparatus to a
volume in said another storage apparatus connected to
said another storage apparatus connecting means.

25   [Claim 3]   The operating/managing system of said storage
apparatuses as claimed in Claim 1, wherein said storage
apparatus connected to said storage apparatus connecting
means comprises property inputting means for inputting

said property information into said property holding
means.

[Claim 4]   The operating/managing system of said storage
apparatuses as claimed in Claim 1, further comprising:

5   request property selecting means for selecting
a property of a storage apparatus required by said
computer;

          property comparing means for making a
comparison between said information held in said storage
10   apparatus property holding means and said information
selected by said request property selecting means; and

          comparison result indicating means for
indicating a result of said comparison.

[Claim 5]   The operating/managing system of said storage
15   apparatuses as claimed in Claim 2, wherein said
information duplicating means comprises:

          information amount counting means for counting
an amount of said information duplicated from said
storage apparatus to said another storage apparatus; and

20   information amount indicating means for
indicating a result of said counting.

[Claim 6]   The operating/managing system of said storage
apparatuses as claimed in Claim 5, wherein said
information amount indicating means indicates said
25   information amount inputted by price inputting means
such that, in correspondence with said information
amount counted by said information amount counting
means, said information amount has been converted into

price information by price converting means.

[Claim 7]   An operating/managing method in an operating/
managing system of storage apparatuses, comprising the
steps of:

5   causing a storage apparatus to be specified,
said storage apparatus being in use at present;

            causing a property to be specified, said
storage apparatus being requested to exhibit said
property;

10   causing a particular storage apparatus to be
selected from among candidates of storage apparatuses
indicated from said operating/managing system;

            requesting said selected storage apparatus to
create a volume; and

15   instructing said selected storage apparatus to
start duplication of data.

[Claim 8]   The operating/managing method of said storage
apparatuses as claimed in Claim 7, subsequently to said
step of causing said particular storage apparatus to be
20 selected, said operating/managing method further
comprising a step of:

            indicating a fee needed for said duplication
of said data.

[Claim 9]   The operating/managing method of said storage
25 apparatuses as claimed in Claim 7, subsequently to said
step of requesting said creation of said volume, said
operating/managing method further comprising a step of:

            charging a fee to a storage apparatus

operating system that owns said selected storage
apparatus.

[Detailed Description of the Invention]
5   [0001]
[Technical Field pertinent to the Invention]
        The present invention relates to a method of
utilizing a storage apparatus in an information
processing system. In particular, it relates to a
10 method of utilizing a storage apparatus and its storage
areas in the case where the operation and the management
of the storage apparatus are outsourced. More
specifically, it relates to a method of selecting the
storage areas and a method of migrating data held within
15 the storage areas.
      [0002]
[Background Art]
        In general, the storage apparatus is used with
a computer system, thereby holding data and programs.
20 In accordance with a request from the computer system,
the storage apparatus is capable of writing-in,
modifying, or reading-out the data and the programs.
      [0003]
        The prevalence of computers and the Internet
25 is now increasing electronic information explosively.
In accompaniment therewith, the storage apparatus itself
also continues to be increased. As a result, a company
that owns a computer system must add-on and manage the

storage apparatus in agreement with the information that continues to be increased. The operating/managing cost of the storage apparatus in a company is basically classified into the introduction cost of the storage

5 apparatus and the management cost thereof. Concerning the capacity of the storage apparatus, however, as the capacity is made larger, the system becomes more complicated and thus the cost needed for the operation/management is increased further. On account

10 of this condition, there exist some of the companies that make a plan to outsource the operation/management of the storage apparatus to the experts in order to reduce the operating/managing cost.

[0004]

15 Meanwhile, in recent years, SSPs (: Storage Service Providers) that undertake the operation/ management of the storage apparatus at a company's request have been getting started up. A company, i.e., a SSP's customer, requests the SSP to rent out a portion

20 of storage area (i.e., a volume) of the storage apparatus, then outsourcing the operation/management of the volume to the SSP. This outsourcing makes it possible to reduce the operating/managing cost needed for the storage apparatus ("Service Business Supporting

25 SSP", the Japanese periodical "Nikkei System Provider" pp50-57, March 16, 2001).

[0005]

[Problem to be solved by the Invention]

As the number of the SSPs increases, a company finds it impossible to readily judge which SSP gives the company a good service to receive. Also, once the company made a contract with a certain SSP and started

5 the operation, a large amount of data has been accumulated therein. Accordingly, even if a more charming (e.g., a lower-price, a higher-performance, a higher-reliability, or the like) SSP appears, the company finds it impossible to easily switch over to the

10 more charming SSP.

[0006]

It is an object of the present invention to provide an operating/managing system by which, when a more charming SSP exists than an SSP in use at present

15 in a state where a large number of SSPs have offered services, there is performed a data migration for mediating between the more charming SSP and the user that is using the SSP and for allowing the user to switch over to the more charming SSP. The utilization

20 of the operating/managing system according to the present invention makes it unnecessary to interrupt the accesses to the SSPs even during the offering of the data migration service.

[0007]

25 [Means for Solving the Problem]

In order to accomplish the above-described object of the present invention, in an information processing system including a computer and storage

apparatuses, the operating/managing system of the storage apparatuses is provided among the computer and the storage apparatuses. The present operating/managing system includes a computer connecting unit for establishing the connection with the computer, two or more storage apparatus connecting units for establishing the connections with the plurality of storage apparatuses, a property holding unit for holding the properties (i.e., information on the performance, the price, the reliability, and the like) of the connected storage apparatuses, and a storage apparatus information holding unit for holding information on a storage apparatus in use at present and a storage apparatus of the migration destination.

[0008]

Moreover, the present operating/managing system includes a connection destination switching unit for distributing information into the storage apparatus connecting units in a state where the destination address of the information has been switched in accordance with the information held in the storage apparatus information holding unit, the information being received at the computer connecting unit, and an information duplicating unit for controlling the reading-out of information from the storage apparatus and the writing-in of the information into the storage apparatus on the basis of the information held in the storage apparatus information holding unit. The use of

the connection destination switching unit and the

information duplicating unit allows the present

operating/managing system to migrate the information

without suspending the accesses to the storage

5   apparatuses from the computer.

[0009]

Furthermore, the present operating/managing

system includes a volume requesting unit for requesting

the allocation of a volume to the storage apparatus

10   connected to the storage apparatus connecting units, and

the storage apparatus connected to the storage apparatus

connecting units includes a volume allocating unit.

This permits the volumes to be allocated as required

between the present operating/managing system and the

15   storage apparatuses.

[0010]

Also, the storage apparatus connected to the

storage apparatus connecting units in the present

operating/managing system may include a property

20   inputting unit for inputting the property information

into the property holding unit.

[0011]

Also, the present operating/managing system

may further include a request property holding unit for

25   holding the properties of a storage apparatus required

by the computer, a property comparing unit for making a

comparison between the information held in the storage

apparatus property holding unit and the information held

in the request property holding unit, and a comparison result indicating unit for indicating the comparison results.

[0012]

5   Also, the information duplicating unit in the present operating/managing system may include an information amount counting unit for counting the information amount duplicated by the information duplicating unit and an information amount indicating

10   unit for indicating the counted result. In addition, the information amount indicating unit may include a price inputting unit for inputting the price needed for a duplication per unit information amount, and a price converting unit for indicating the duplicated

15   information amount in such a manner as to be converted into a cost that has been needed for the duplication.

[0013]

[Best Mode for Carrying Out the Invention]

       Hereinafter, referring to the drawings, the

20   explanation will be given below concerning an embodiment of the present invention.

(1) system configuration

       FIG. 1 illustrates the configuration of the present embodiment. In the embodiment in FIG. 1, three

25   SSPs (: Storage Service Providers) 30a to 30c are connected to a network 24. Also, a computer 12 and a management console 16 in a client-side computer system 10 that utilizes the SSPs are also connected to the

network 24 via a network router 14 and a path 90.
Although, in the present embodiment, the network 24 has
been assumed to be the IP (i.e., Internet Protocol)
network, the unit of implementing the network does not
5   limit the present embodiment.

[0014]

Also, in the present embodiment, the three
SSPs 30a to 30c will be explained, assuming that the
three SSPs have one and the same configuration.
10   Actually, among the three SSPs, storage apparatuses 310
differ in their numbers, their configurations, and their
connections inside. The differences, however, exert no
influences on the carrying-out of the present invention.
The respective SSPs 30 include the plurality of storage
15   apparatuses 310, and each storage apparatus 310 includes
therein a plurality of volumes 312, respectively. In
addition, the storage apparatuses 310 are connected to
the network 24 via a network router 301. The respective
SSPs 30, using a managing console 305, manage the
20   storage apparatuses 310 in the respective SSPs, the
volume s 312 in the storage apparatuses, and the network
router 301.

[0015]

The computer 12 in the client-side computer
25   system 10 that utilizes the SSPs uses the volumes 312 in
the storage apparatuses 310 in the SSPs 30, then
outsourcing the operation/management of the storage
apparatuses 312 to the SSPs 30. This outsourcing makes

it possible to reduce the TCO (: Total Cost of
Ownership) needed for the operation/management of the
storage apparatuses. The respective SSPs rent out the
volumes 312 in the storage apparatuses 310 and undertake
5   the operation/management of the volumes, thereby
obtaining an income from the client.
(2) packet

The transmission of a read/write request and
data between the computer 12 and the storage apparatuses
10   310, the transmission between the management consoles
16, 305 and an operating/managing system 500, and the
like are performed via the network router 14, the
network 24, and the network router 301. In the IP
network, the transmission among the apparatuses are
15   performed in a data unit referred to as "a packet".
FIG. 2 illustrates the configuration of the packet 100.
The packet includes at least the following three
information-storing areas: A source address holding
area 101, a destination address holding area 102, and a
20   command/data holding area 103.

[0016]

In the present embodiment, the IP network has
been utilized as the network. Accordingly, based on an
address stored in the destination address holding area
25   102 in the packet 100, the packet 100 is transferred to
an apparatus having the matching address (the network
routers play the role of this packet transfer).
Consequently, each apparatus becoming the source

apparatus or the destination apparatus must have its own
specific address. In the case of the system
configuration in FIG. 1, the computer 12, the storage
apparatuses 310, the managing consoles 16 and 305, the
computer connecting unit 50, the storage apparatus
connecting units 51, and so on have their own specific
address each. This address is referred to as "an IP
address".

(3) Network routers and network

FIG. 3 illustrates an example of the
configuration of the network 24. The network is a
formed of a plurality of networks mutually
interconnected by a plurality of network connection
equipments (called routor). When a network router 110
receives a packet, the network router 110 fetches the
destination address from the destination address holding
area in the packet, then judging to which network router
(or apparatus) the network router should transfer the
packet next. For this purpose, the network router has a
table referred to as "a routing table" and, based on
this routing table, the network router judges the next
transfer destination of the packet.

(4) initial connection state and necessity for switching
over

Hereinafter, in the present embodiment, the
explanation will be given, defining, as an initial
state, a state where the computer system 10 utilizes one
of the volumes 312 in the SSP 30a. Usually, the SSP 30

rents out the volumes to a plurality of clients. The
network router 14 connected to the computer 12 selects
the path 90 so as to establish the connection with the
network 24. A read/write request from the computer 12
to the volume 312 in the storage apparatus 310 is
transmitted to the storage apparatus 310 via the network
router 14, the network 24, and the network router 301.
When one storage apparatus has the plurality of volumes,
the computer specifies the volume number of a particular
volume, thereby accessing the particular volume. If the
client that owns the computer system 10 utilizing the
SSP 30a has no complaints about the service offered by
the SSP 30a, the client need not switch over from the
SSP 30a to another SSP. Accordingly, there is no
problem in continuing the outsourced operation of the
storage apparatus with the above-described initial state
left unchanged.

[0017]

If, however, a more charming (e.g., a lower-
price, a higher performance, a higher-reliability, or
the like) SSP exists, there is a necessity for
considering the switching over between the SSPs. Also,
when performing the switching over, the data held in the
SSP 30a at present needs to be migrated to the switching
destination SSP. Hereinafter, in the present
embodiment, the explanation will be given below
concerning a method and a unit for selecting an aimed-at
SSP from among the plurality of SSPs and a method for

migrating the data after the determination of the

switching destination SSP with the use of the

operating/managing system 500 according to the present

invention.

5 (5) selection of SSPs

In the case of the system configuration in

FIG. 1, the three SSPs 30a to 30c are registered in and

are connected to the operating/managing system 500

according to the present invention. The

10 operating/managing system 500 includes property holding

units 52 (in the case of the present embodiment, three

property holding units 52a to 52c) for holding the

properties of the respective SSPs.

[0018]

15 FIG. 10 is a flowchart for explaining the

property information setting from the SSPs.

Using a property inputting unit 303, the

respective SSPs transmit the property information to the

operating/managing system 500 from the managing console

20 305 (steps 1001, 1003, and 1005). The

operating/managing system 500 stores the received

property information into the property holding units 52

corresponding to the respective SSPs (steps 1002, 1004,

and 1006). The property information inputted by the

25 property inputting unit 303 are registered into the

property holding units 52 via the network router 301,

the network 24, and storage apparatus connecting units

51. The exchanges of the property information between

the property inputting unit 303 and the property holding

units 52 are also performed using the packets.

[0019]

The properties of each SSP are information on

5   the performance, the price, the reliability, and the

like.   The performance is indicated by the per-second

receivable access number, the transfer rate, and the

average response time.   The price is indicated by the

per-unit-capacity cost.   The reliability is indicated by

10 the RAID level, the mirror configuration with a remote

site, and the back-up interval.

[0020]

In the present embodiment, the property

holding units 52a to 52c corresponding to the respective

15 SSPs include areas illustrated in FIG. 4, respectively,

thus holding the property information.   In the case of

FIG. 4, each property holding unit includes the

following three holding areas: A performance holding

area 161 (the average response time), a price holding

20 area 162 (the per-giga-byte cost), and a reliability

holding area 163 (the RAID level, the presence or

absence of the mirror with a remote site, and the back-

up interval).   Also, in FIG. 4, each property holding

unit further includes an IP address holding area 165

25 that holds an IP address for accessing each SSP, and a

written-contract holding area 166 for holding all the

sentences of a written-contract required for a contract

made with the client.   At the time of the inputting of

the property information from each SSP, a representative

IP address becoming the first contact point of each SSP

is also inputted. The representative IP address

inputted here is utilized when a volume area creating

5   request or the like is issued from the

operating/managing system 500 to each SSP.

[0021]

In the present embodiment, the explanation

will be given below, assuming that the respective three

10   SSPs have the following properties (FIG. 4): The

properties of the SSP 30a in use at present are 10 ms

average response time, $100/GB, RAID5, no mirror with a

remote site, and 168-hour back-up interval (once a

week). The properties of the SSP 30b are 5 ms average

15   response time, $200/GB, RAID1, mirror with a remote

site: present, and 24-hour back-up interval (once a

day). The properties of the SSP 30c are 50 ms average

response time, $50/GB, RAID5, no mirror with a remote

site, and 24-hour back-up interval (once a day).

20   [0022]

A client that is considering the switching

over between SSPs registers an SSP that the client uses

at present, using a storage apparatus specifying unit 53

from the managing console 16 via the network router 14

25   and the computer connecting unit 50. In the initial

state of the present embodiment, since the computer

system 10 has utilized the SSP 30a, the client registers

the SSP 30a. The SSP in use at present, which has been

set by the storage apparatus specifying unit 53, is held into a storage apparatus information holding unit 58.

[0023]

The storage apparatus information holding unit 58 holds a table illustrated in FIG. 5. The table includes, concerning storage apparatuses in the SSPs, an IP address holding area, a volume number holding area 581, an SSP name holding area, and a valid bit holding area 582 for indicating whether or not the information are valid. The valid bit holding area, the IP address holding area, and the volume number holding area are configured so that a plural pieces of information can be held.

(6) screen for registration

FIG. 6 illustrates a screen image used in the storage apparatus specifying unit 53. A window screen 120 illustrated in FIG. 6 includes an explanation frame 125 for explaining the present window, an SSP name inputting frame 121 for inputting an SSP name in use at present, an IP address inputting frame 122 for inputting the IP address of a storage apparatus in use at present, and a volume number inputting frame 123 for inputting the volume number.

[0024]

FIG. 11 illustrates a flowchart concerning a processing for setting information on the storage apparatus that the client uses at present. The information inputted via the inputting frames

illustrated in FIG. 6 (a step 1101), if an "OK" button

128 is pushed (a step 1102), is held into the table of

the storage apparatus information holding unit 58

illustrated in FIG. 5 (a step 1104). Pushing a "CANCEL"

5 button (the step 1102) cancels the inputting processing

(a step 1109).

[0025]

FIGS. 12, 13, and 14 illustrate flowcharts

regarding the processings for switching over between the

10 SSPs.

(7) packet processing by network router (a step 1201 in

FIG. 12)

A read/write request made by the computer 12

of the computer system 10 toward the storage apparatus

15 310 in the SSP 30a, in the initial state, is made by the

network router 14 via the path 90.

[0026]

In view of this situation, the client of the

computer system 10 that is considering the switching

20 over between the SSPs switches the setting of the

network router 14 (the step 1201) so that the exchange

of the packet with the storage apparatus 310 will be

performed via a path 91. Then, the network router 14

selects the path 91, and accordingly the packet issued

25 by the computer 12 toward the storage apparatus 310 in

the SSP 30a is transferred to the computer connecting

unit 50.

[0027]

The operating/managing system 500 according to the present invention transfers, to the connection destination switching unit 520, the packet received by the computer connecting unit 50. The connection destination switching unit 520 substitutes the source address of the packet by the IP address of the storage apparatus connecting unit 51a. It is preferable to leave the destination address of the packet as it is, i.e., the IP address of the storage apparatus 310 in the SSP 30a. The substitution of the source address of the packet by the storage apparatus connecting unit 51a allows a response from the storage apparatus to be received at the operating/managing system 500. The connection destination switching unit 520 transfers, to the storage apparatus connecting unit 51a, the packet the source address of which has been replaced. The storage apparatus connecting unit 51a issues the packet to the network 24. Since, in the packet, the IP address of the storage apparatus 310 in the SSP 30a has been held as the destination address, the packet is delivered without fail to the target storage apparatus 310 in the SSP 30a via the network router 301.

[0028]

The response from the storage apparatus 310 is performed in accordance with the source address that the connection destination switching unit 520 has intentionally replaced, and consequently the response packet is delivered to the storage apparatus connecting

unit 51a. Having received the response packet, the storage apparatus connecting unit 51a transfers the response packet to the connection destination switching unit 520. The connection destination switching unit 520

5   intentionally replaces the destination address by the IP address of the computer 12. Furthermore, the response packet replaced by the IP address is transferred to the computer connecting unit 50. This permits the response packet from the storage apparatus 310 to be delivered

10 without fail to the computer 12 via the network router 14.

[0029]

The setting described above switches the setting of the network router 14, thereby making it

15 possible to access the SSP 30a by way of the operating/managing system 500 according to the present invention. In this way, using the storage apparatus specifying unit 53, the SSP in use at present (in the case of the present embodiment, the SSP 30a) is set in

20 advance. This setting allows the implementation of the switching to the path by way of the operating/managing system 500 without interrupting the processing at the computer 12. Also, after the switching, this setting makes it possible to continue the operation with the SSP

25 30a.

(8) inputting of request properties and indication of candidates (a step 1202 in FIG. 12)

Next, using a request property selecting unit

54 from the managing console 16 via the network router
14 and the computer connecting unit 50, the client of
the computer system 10 that is considering the switching
over between the SSPs registers what SSP the client

5 needs (the step 1202). In the case of the present
embodiment, there are provided the following three
alternatives: The three alternatives are three items of
"lower-price", "higher-performance", and "higher-
reliability".

10 [0030]

In the case of selecting the alternative of
"lower-price", a property comparing unit 56 makes a
comparison between the property information held in the
property holding unit 52a of the SSP 30a in use at

15 present and the property information held in the other
property holding units 52b and 52c, thereby indicating,
as a candidate, the SSP 30c of the lower price via a
comparison result indicating unit 55. In this case, the
property comparing unit indicates, via the comparison

20 result indicating unit 55, the condition that the cost
becomes cheaper but the performance (i.e., the response
time) is lowered from 10 ms down to 50 ms.

[0031]

In the case of selecting the alternative of

25 "higher-performance", the property comparing unit 56
makes the comparison in much the same way, thereby
indicating, as a candidate, the SSP 30b of the higher
performance. In this case, the unit indicates, via the

comparison result indicating unit 55, the condition that the performance is enhanced but the cost becomes higher from $100/GB up to $200/GB.

[0032]

In the case of selecting the alternative of "higher-reliability", the property comparing unit 56 makes the comparison in much the same way, thereby indicating, as candidates, the SSPs 30b and 30c of a higher reliability (i.e., the mirror with a remote site is present, and the 24-hour back-up interval). In this case, the property comparing unit 56 estimates the RAID level 1 and the RAID level 5 as the equal reliability (the RAID 1 results from the data protection by the mirror configuration, and the RAID 5 results from the data protection by the parity). Of course, the property comparing unit indicates, via the comparison result indicating unit 55, the condition that, in the case of selecting the SSP 30b, the performance is enhanced but the cost also becomes higher, and the condition that, in the case of selecting the SSP 30c, the performance is lowered by the amount equivalent to the cost made cheaper.

[0033]

Based on the contents indicated by the comparison result indicating unit 55, the client that uses the SSP 30a at present can make a decision as to whether or not the client should switch over from the SSP 30a to another SSP.

(9) screen for selection and decision of switching over
(steps 1203 to 1210 in FIG. 12)

FIG. 7 illustrates a screen image used in the
request property selecting unit 54 and the comparison
result indicating unit 55. Although a screen may be
designed for each of the units independently, in the
present embodiment, the one screen includes the two
units. FIG. 7 illustrates the comparison results
indicated in the case of selecting the alternative of
"higher-reliability" in the above-described description.
The window screen illustrated in FIG. 7 includes a
request property selecting frame 130 for selecting the
request properties, a comparison result displaying frame
140 for displaying the comparison results by the
property comparing unit, and a decision making frame 150
for prompting a judgment of starting the migration
between the SSPs.

[0034]

The frame 130 includes three checking boxes
131 to 133 for selecting the request properties. The
three checking boxes correspond to "lower-price",
"higher performance", and "higher-reliability",
respectively. It is also possible to select a plurality
of checking boxes simultaneously. For example, when
wising to suppress the cost and to enhance the
performance, it is appropriate to check the checking
boxes for the two items of "lower-price" and "higher
performance". After having checked at least one of the

three checking boxes 131 to 133, pushing a "retrieval" button (the step 1203) causes the property comparing unit 56 to make a comparison among the contents held in the property holding units 52a to 52c (the step 1204).

5 Moreover, the property comparing unit displays the comparison results on the comparison result displaying frame 140 (the step 1205).

[0035]

On the comparison result displaying frame 140,

10 the SSP in use at present and the SSPs of the candidates therefor are indicated in a table format. The candidates are provided with radio buttons 141 and 142, and it is possible to select either of the candidates. If the candidate is selected (the step 1206), all the

15 sentences of a written-contract with the selected candidate 30b are indicated on a written-contract displaying frame 159 provided in the frame 150 (the step 1207). All the sentences of the written-contract have been held in the written-contract holding area 166 in

20 the property holding unit 52b. If all the sentences are not involved in the frame, scrolling the written-contract makes it possible to display all the sentences.

[0036]

Next, if an "OK" button 151 is selected (the

25 step 1208), judging that the contract with the SSP 30b has been completed, a data migration processing from the SSP 30a to the newly selected SSP 30b is started. Here, pushing a "CANCEL" button 152 interrupts the processing

at this point-in-time (the step 1209). When the "OK"

button is pushed, the storage apparatus specifying unit

53 holds, into the migration destination storage

apparatus 582 in the storage apparatus information

5 holding unit 58 in FIG. 5, the representative IP address

and the SSP name of the SSP selected as the migration

destination (the step 1210).

[0037]

At this point-in-time, however, the volume

10 number has been not determined yet. Accordingly, the

volume number column is set to be a blank. The valid

bits are not set. In FIG. 7, although SSP 30a and SSP

30b have been used as the SSP names, it is also possible

to use some designations that are easier to understand

15 concretely than the company names or the like.

[0038]

Next, assuming that, on the window illustrated

in FIG. 7, the SSP 30b has been selected as the SSP of

the migration destination, the explanation will be given

20 regarding the data migration processing.

(10) indication of price (steps 1211 to 1213 and 1299 in

FIG. 12)

On the window illustrated in FIG. 7, if the

SSP 30b is selected as the SSP of the migration

25 destination and the "OK" button 151 is pushed, an

information amount counting unit 550 acquires, via an

information duplicating unit 510, the storage capacity

of the volume 312 in the SSP 30a in use at present (the

steps 1211, 1299).

[0039]

Usually, the volume 312 is managed as a group of blocks having addresses referred as to "LBA (: Logical Block Address)". The final LBA of the volume is multiplied by the per-block byte number (usually, in many cases, the n-th power of 2, e.g., 512 bytes), thereby being capable of determining the data amount to be migrated. The information amount counting unit 550, based on the storage capacity of the volume 312 in the SSP 30a, calculates the cost needed for the data migration toward the client of the computer system 10 (the step 1212), then, via an information amount price indicating unit 552, indicating the cost needed for the data migration (the step 1213).

[0040]

FIG. 8 illustrates a window image 180 used in the information amount price indicating unit 552. The storage capacity of the volume that the information amount counting unit 550 has acquired is converted into price information (i.e., the cost) by a price converting unit 555. In addition, the information amount price indicating unit 552 indicates the price toward the client via a price indicating frame 181. The data on which this conversion is based (e.g., the per-capacity cost) can be inputted from a price inputting unit 559. As illustrated in FIG. 8, in addition to the indication of the price, it is also allowable to indicate, via a

data amount indicating frame 182, the total data amount to be migrated. The fee indicated here must be paid from the client that uses the computer system 10 to the company that operates the present operating/managing system.

(11) preparation for migration starting (i.e., creation of volume) (steps 1214 to 1221 in FIG. 13)

If, on a window illustrated in FIG. 8, an "OK" button 188 is pushed (the step 1214) and an approval for the cost needed for the migration is obtained, in order to migrate the data, the operating/managing system 500 at first creates a new volume in the SSP 30b selected as the migration destination. Here, pushing a "CANCEL" button 189 results in no data migration and interrupts the processing at this point-in-time (the step 1215).

[0041]

Based on the representative IP address stored in the IP address holding area in the migration destination storage apparatus 582 of the storage apparatus information holding unit 58 illustrated in FIG. 5, a volume requesting unit 57 in the operating/ managing system 500 requests a volume allocating unit 302 in the SSP 30b to allocate a volume (the step 1216). When the volume allocating processing is completed (the step 1217), the volume allocating unit 302 returns the IP address and the volume number of an allocated storage apparatus back to the volume requesting unit 57 (the step 1218). The volume requesting unit 57 stores the IP

address and the volume number of the received storage apparatus into the storage apparatus information holding unit 58 (the step 1219), then setting the valid bit to be "1" (the step 1220).

5   [0042]

The volume requesting unit 57 leaves, in a log inside, information that the new volume has been created in the SSP 30b. It turns out that the operating/managing system 500 has introduced a new

10 client to the SSP 30b. Consequently, in accordance with the information left in the log, the operating/ managing system 500 charges the SSP 30b a new client introduction fee (the step 1221). The volume requesting unit 57 can perform the charging of this introduction fee

15 electronically toward the managing console 305 in the SSP 30b, or can perform the charging in accordance with a non-electronic method such as a bill on the basis of the information in the log.

(12) packet processing during migration processing

20   When the valid bit of the migration destination storage apparatus 582 in FIG. 5 is set to be "1", thereinafter, the connection destination switching unit 520 creates one copy of a packet that the unit 520 has received from the computer connecting unit 50. As

25 described earlier, the source address of the received original packet is intentionally replaced by the IP address of the storage apparatus connecting unit 51a, then transferring the original packet to the storage

apparatus connecting unit 51a. Meanwhile, the source
address of the copied packet is intentionally replaced
by the IP address of the storage apparatus connecting
unit 51b, and the destination address thereof is

5 intentionally replaced by the IP address of the storage
apparatus 310 in the SSP 30b (i.e., the IP address
specified earlier by the volume allocating unit 302),
then transferring the copied packet to the storage
apparatus connecting unit 51b.

10 [0043]

The above-described processing causes the
original packet to be delivered to the SSP 30a, and
causes the copied packet to be delivered to the SSP 30b
of the migration destination. Responses to the

15 respective packets are returned back from the respective
storage apparatuses 310. The response packet from the
SSP 30a is received by the storage apparatus connecting
unit 51a. Then, the connection destination switching
unit 520 substitutes the source address by the IP

20 address of the computer 12, thereby returning the
response packet back to the computer 12 without fail.
The response packet from the SSP 30b of the migration
destination is received by the storage apparatus
connecting unit 51b, then being transferred to the

25 connection destination switching unit 520. The
connection destination switching unit 520 checks the
received response packet, and if the destination address
thereof is the storage apparatus connecting unit 51b,

the unit 520 discards the response packet.

[0044]

Creating the copy of the packet as described above allows a write data issued by the computer 12 to

5   be written into the volumes in both of the SSP 30a and the SSP 30b. This permits the newest data to be always held in both of the SSP 30a and the SSP 30b. Also, read data is transmitted to the computer 12 only from the SSP 30a.

10   (13) duplication of data (steps 1230, 1231, and 1239 in FIG. 13)

When the valid bit of the migration destination storage apparatus 582 in FIG. 5 is set to be "1", thereinafter, the information duplicating unit 510

15   starts the duplication of the data from the volume in the SSP 30a to the volume in the SSP 30b. The data from the head LBA to the final LBA of the volume in the SSP 30a are duplicated into the volume in the SSP 30b (the step 1230). The information duplicating unit 510 issues

20   a read request to the volume in the SSP 30a so as to read out the data, then issuing a write request to the volume in the SSP 30b so as to write the read-out data therein. This processing is performed up to the final LBA while incrementing the LBA. During the duplication

25   processing, the information duplicating unit 510 indicates the progressing situation of the copy toward the client by a progress indicating unit 59 (the step 1231). The employment of a bar graph or the like

displays the progress such as the percentage.

[0045]

When the information duplicating unit 510 completes the duplication up to the final LBA, perfectly the same data have been written into the volume in the SSP 30a and the volume in the SSP 30b. When the duplication is completed, the information duplicating unit 510 resets, to be "0", the valid bit of the in-use storage apparatus 581 in the storage apparatus information holding unit 58 in FIG. 5 (the step 1239). (14) packet processing after completion of data duplication

When the valid bit of the in-use storage apparatus 581 in the storage apparatus information holding unit 58 in FIG. 5 is reset to be "0", the connection destination switching unit 520, judging that the duplication has been completed, thereinafter switches the packet processing. Namely, although the unit 520 has been creating the copy of the packet during the duplication, it stops the packet duplication. Moreover, the source address of the packet received from the computer connecting unit and the destination address thereof are intentionally replaced by the IP address of the storage apparatus connecting unit 51b and the IP address of the storage apparatus 310 in the SSP 30b, respectively, then issuing the packet to the storage apparatus connecting unit 51b. This causes the packet to be delivered only to the aimed-at volume in the SSP

30b of the migration destination.

[0046]

The response from the storage apparatus 310 is performed in accordance with the source address that the connection destination switching unit 520 has intentionally replaced, and consequently the response packet is delivered to the storage apparatus connecting unit 51b. Having received the response packet, the storage apparatus connecting unit 51b transfers the response packet to the connection destination switching unit 520. The connection destination switching unit 520 intentionally replaces the destination address by the IP address of the computer 12. Furthermore, the response packet replaced by the IP address is transferred to the computer connecting unit 50. This permits the response packet from the storage apparatus to be delivered without fail to the computer 12 via the network router 14.

(15) setting switching of computer 12 and that of network router 14 (a step 1240 in FIG. 13 to a step 1243 in FIG. 14)

Finally, it is required to switch the setting of the computer 12 so that the issuing destination of the packet will be switched from the IP address and the volume number of the storage apparatus 310 in the SSP 30a to the IP address and the volume number of the storage apparatus 310 in the SSP 30b. In order to perform the switching, it is necessary to know the IP

address and the volume number of the new SSP 30b of the migration destination. Having confirmed the fee payment from the client that owns the computer system 10 (the step 1240), the operating/managing system 500 notifies the computer system 10 of the IP address and the volume number of the SSP 30b (the step 1241).

[0047]

In accordance with the IP address and the volume number notified, the issuing destination of the packet from the IP address and the volume number of the storage apparatus 310 in the SSP 30a is switched to the IP address and the volume number of the storage apparatus 310 in the SSP 30b (the step 1242) in the computer system 10. Even if this switching has been performed, since the setting of the network router 14 has been not switched, the packet is delivered to the operating/managing system 500. Accordingly, if, in this state, the connection destination switching unit 520 receives the packet, there occurs no problem because the connection destination switching unit still continues the intentional replacement of the packet.

[0048]

Next, the setting of the network router 14 is switched so that the packet will be sent to the network 24 with the use of the path 90 (the step 1243). This switching makes it possible to access the SSP 30b without the involvement of the operating/managing system 500.

[0049]

A program for implementing the linkage with
the operating/managing system 500 is prepared on the
computer system 12. By doing this, the setting
switching of the computer 12 and that of the network
router 14 in the computer system 10 can also be
performed from the operating/managing system 500.
(16) utilization of storage apparatus inside system

As illustrated in FIG. 1, a storage apparatus
599 provided inside the operating/managing system 500
may be used for migrating the data between the SSPs. In
this case, for example, the data stored in the volume in
the SSP 30a is duplicated into the storage apparatus 599
once. The packet processing during the duplication is
basically the same as the processing described already.
Next, in the case where the SSP of the migration
destination is the SSP 30b, the data duplication is
performed from the storage apparatus 599 to the SSP 30b.
The packet processing during the duplication in this
case is also basically the same as the processing
described already. In the case where the migration
between the SSPs cannot be performed immediately because
of the circumstances on the contract time-periods with
the SSP 30a and the SSP 30b, the use of the storage
apparatus 599 provided inside the operating/managing
system 500 also makes it possible to temporarily
commission the operation/management to the storage
apparatus 599.

(17) duplication of a plurality of volumes

The above-described explanation has been given concerning the case where the computer system 10 duplicates the one volume 312 in the SSP 30a into the one volume 312 in the SSP 30b. However, in the case where the computer system 10 has used the plurality of volumes 312 in the SSP, each of the plurality volumes needs to be duplicated. There exist two methods of duplicating the plurality volumes.

[0050]

The first method is a method of duplicating the volumes one by one. For this purpose, as illustrated in FIG. 5, the table that the storage apparatus information holding unit 58 holds is configured so that a plurality of IP addresses and volume numbers can be held. Using this table, the SSP is switched in sequence from a volume the duplication of which has been finished. The second method is a method of using the plurality of information duplicating units 510. This method makes it possible to duplicate the plurality of volumes simultaneously.

(18) support for a plurality of clients

Also, as illustrated in FIG. 9, by preparing an operating/managing system 600 where the operating/managing systems 500 illustrated in FIG. 1 are provided in a plural number, it becomes possible to offer the service to the plurality of clients simultaneously.

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(19) indication of fees

In the present embodiment, the operating/
managing system 500 has performed the charging of the
new client introduction fee toward the SSP (the step
1222) and the charging of the fee in correspondence with
the data migration amount toward the client that
requested the migration between the SSPs (the step
1213). The chargings of these fees may be performed
only by either of these methods. Also, the fees can be
charged regardless of the data amount. Of course, it is
also allowable to perform the fee chargings in
correspondence with the fundamental fee and the fee in
correspondence with the data migration amount.

(20) inputting of information on SSP 30a

In the present embodiment, it turns out that,
when seen from the SSP 30a, the client has been taken
away by the SSP 30b. Consequently, the SSP 30a is not
necessarily willing to register the property information
into the operating/managing system 500. In this case,
even if, on the window 120 illustrated in FIG. 6 in the
storage apparatus specifying unit 53, the client inputs
the SSP name that the client uses at present, there are
some cases where the property holding unit 56 holds none
of the property information on the corresponding SSP.
In this case, the client may provide the property
holding unit 56 with the property information on the SSP
30a in use at present.

(21) application of SSP 30b to service

Also, the SSP 30b may operate the present
operating/managing system 500. Namely, the SSP 30b
requests the client to input the property information on
the SSP that the client uses at present, and compares
5   the property information with the property information
on the SSP 30b, thereby indicating the superiority of
the SSP 30b. Then, if the SSP 30b has succeeded in
acquiring the client that uses the SSP 30a at present,
the SSP 30b migrates the data stored in the SSP 30a over
10   to the SSP 30b, using the operating/ managing system 500
according to the present invention. Also, by executing
the present migration processing as an initially
introducing service by the SSP 30b, it becomes possible
to prompt the switching over between the SSPs.
15   [0051]

[Advantages of the Invention]

According to the present invention, the client
that uses an SSP at present can compare a plurality of
SSPs and select a needs-meeting SSP from among the SSPs,
20   thereby being capable of completing the data migration
from the one SSP to the other SSP without stopping the
accesses to the SSPs. Also, the computer system is
capable of implementing the data migration only by the
setting switching of the network router and the setting
25   switching of the computer to be performed after the
completion of the data migration. The client that uses
the computer system at present necessitates no special
knowledge about the migration between the SSPs. Also,

the setting switching of the network router and that of the computer to be performed after the completion of the data migration can also be performed from the operating/managing system.

5   [0052]

       When seen from the other SSP, the other SSP is capable of acquiring the new client via the operating/managing system according to the present invention.

10

[Brief Description of the Drawings]
[FIG. 1]
       FIG. 1 illustrates the configuration of the operating/managing system according to the present
15   invention.
[FIG. 2]
       FIG. 2 illustrates a packet.
[FIG. 3]
       FIG. 3 illustrates a network (the IP network).
20   [FIG. 4]
       FIG. 4 illustrates the contents of property holding units.
[FIG. 5]
       FIG. 5 illustrates a table in a storage
25   apparatus information holding unit.
[FIG. 6]
       FIG. 6 illustrates a window image by a storage apparatus inputting unit.

[FIG. 7]

FIG. 7 illustrates a window image by a request property selecting unit and a comparison result indicating unit.

5 [FIG. 8]

FIG. 8 illustrates a window image by a price indicating unit.

[FIG. 9]

FIG. 9 illustrates the configuration of the

10 operating/managing system in the case where the service is offered to a plurality of customers.

[FIG. 10]

FIG. 10 is a flowchart for explaining the property information setting from SSPs.

15 [FIG. 11]

FIG. 11 is a flowchart concerning a processing for setting a storage apparatus that a client is using at present.

[FIG. 12]

20 FIG. 12 is a (1st) flowchart regarding a processing for switching over between the SSPs.

[FIG. 13]

FIG. 13 is a (2nd) flowchart regarding a processing for switching over between the SSPs.

25 [FIG. 14]

FIG. 14 is a (3rd) flowchart regarding a processing for switching over between the SSPs.

[Description of Reference Numerals]

10...computer system, 12...computer, 14...network router, 16...management console, 24...network, 30...SSP, 50...computer connecting unit, 51...storage apparatus connecting units, 52...property holding units, 53...storage apparatus specifying unit, 54...request property selecting unit, 55...comparison result indicating unit, 57...volume requesting unit, 58...storage apparatus information holding unit, 110...network router, 161...performance holding area, 162...price holding area, 163...reliability holding area, 165...IP address holding area, 301...network router, 302...volume allocating unit, 303...property inputting unit, 305...managing console, 310...storage apparatuses, 312...volume, 510...information duplicating unit, 520...connection destination switching unit, 550...information amount counting unit, 552...information amount price indicating unit, 555...price converting unit, 559...price inputting unit

[Kind of Document]   Abstract

[Abstract]

[Problem]

   If the SSPs (: Storage Service Providers) that
5 undertake the operation/ management of storage

apparatuses exist in large number, a company finds it

impossible to readily judge which SSP gives the company

a good service to receive. Also, once the company made

a contract with a certain SSP and started the operation,
10 the company finds it impossible to easily switch over to

a more charming (e.g., a lower-price, a higher-speed, a

higher-reliability, or the like) SSP.

[Solution Means]

   In an information processing system including
15 a computer and the storage apparatuses, an

operating/managing system provided among the computer

and the storage apparatuses includes the following

units: A connection destination switching unit and an

information duplicating unit for implementing the
20 migration between the SSPs without interrupting the

accesses to the storage apparatuses from the computer,

and a request property selecting unit, a property

comparing unit, and a comparison result indicating unit

for assisting the selection of a purpose-fitting SSP
25 from among the plurality of SSPs.

[Selected Drawing]   FIG. 1